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Reprinted from
THE JOURNAL OF GEOGRAPHY
VOL. IX., No. IV. DECEMBER, 1910

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CLIMATE AS RELATED TO INDUSTRY AND COMMERCE*

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TEMPERATURE

THE annual recurrence of spring and winter, in regions outside of the tropics, with the resulting resurrection and death of many forms of plant life, is our most familiar and striking illustration of the relation between vegetation and temperature. To see Nature's carpet of white give place to one of softest green; to see the bare, gray branches of the forest trees gradually hidden by luxuriant foliage; to see fruit trees glorifying the landscape with their wealth of pink and white blossoms; to see fields of grain turning golden in the summer sunshine, ripening their seed, and thus perpetuating their kind, is to witness a truly wonderful transformation.

We may observe a similar relation between plants and temperature by making an extended journey along a meridian. In equatorial regions near sea level we are surrounded by palms, banana trees, and other characteristic tropical vegetation. As we journey poleward these forms gradually give place to deciduous trees and the more hardy plants of the temperate zone. As higher latitudes are reached, deciduous forests are replaced by coniferous, and in time the poleward limits of grain and trees are reached. Still nearer the poles are areas where only the most hardy forms of plant life can exist, while beyond stretch the realms of everlasting snow.

There is also an altitudinal variation in temperature, there being an average decrease of about one degree Fahrenheit for every 339 feet of ascent, and a consequent variation in plant life. In Mexico orange, lemon, palm, and banana trees, coffee, cotton, sugar-cane and rice are grown within a comparatively short distance of mountains permanently snow covered. In ascending these, and other mountains similarly situated, the traveler passes through all climatic and vegetation zones from tropical to boreal.

The distribution of animal life is, in large measure, governed by temperature, but as most animals are more highly developed than are plants, and as nearly all have the power of locomotion, the control is less marked. Many animals live where high temperatures prevail. Animals living in regions subject to winter conditions meet these conditions by putting on a heavier coat, by burrowing, by hibernating, by constructing shelters, by storing up food or by migrating.

Man, the most highly developed form of life, is also profoundly influenced by temperature conditions. He depends upon plants and ani-

*From a volume being prepared by the author.

mals for food, for clothing, and to a certain extent for shelter and transportation. In earlier ages, therefore, man could not live far from the forms of life upon which he depended, but with the development of the human race have come the marvelous inventions which have made it possible for mankind to live far from the sources of the raw materials which furnish the necessities of life.

Temperature exerts a powerful control over the progress of a people. No great nation has developed within the humid lands of the torrid zone, nor the frozen wastes of the arctic regions. In the one, there is no non-productive season for which provision must be made. Nature is so lavish that there is little incentive to, or need for, labor. Furthermore an atmosphere high in temperature, and reeking with moisture deprives man of energy and ambition. In the other, Nature imposes such hard conditions upon her children that living is reduced to mere existence.

Since, therefore, man's industry, as well as his articles of exchange and commerce, are so inseparably connected with the plant and animal life of the globe, temperature exerts a strong control over industry and commerce in their various forms. There are regions and peoples occupying very important places in the industrial and commercial life of the world, and there are others whose contributions are very limited.

In the northern part of both North America and Eurasia are areas where the summer temperature rises above 32° Fahrenheit for a short time only. Here the ground, below the depth of two or three feet, remains permanently frozen. The growing of crops is prohibited by the short summers and even trees are absent. The only form of vegetation that thrives is the reindeer moss.

As animals depend upon plants or other animals for food, these regions have a limited fauna as well as flora. Here then there are no farms, no forests, no mines, no railroads, no cities, in a word none of the conditions essential to the development of industry and commerce. The unfortunate inhabitants, few in numbers, wage a never-ceasing warfare with Nature, and as a result secure the means of a bare existence.

The distribution of the cotton plant well illustrates the relation of temperature to industry. Cotton requires a moderate amount of rainfall, a relatively high temperature, and a long growing season. These conditions are not met in many large areas. The latitudinal and altitudinal extension of the plant is practically limited by the annual isotherm of 60°F. In the United States this is south of the parallel of 37° and, with the exception of the Imperial Valley and other small sections, east of the one hundredth meridian. In this area there are about seven months between the latest killing frost in spring and the earliest killing frost in autumn. The large area in which these conditions exist makes it possible for the United States to produce about three-fourths of the cotton of the world.

How different would have been the history of the United States had not the South been adapted to the growing of this plant. The influence of temperature upon history, as well as the industrial and commercial phases of life is well brought out by the following: "History shows us that it was only narrowly that the states of Illinois and Indiana escaped the institution of slave-owning within their territories. If the isothermals had been drawn one or two hundred miles farther north, so that the southern crops could have prospered in these states, the evil of slavery might well have been fastened so firmly that it could not have been uprooted from our country." Shaler, *Nature and Man in America*, p. 211. In Colonial days the rapid development of our commerce was in very large measure due to the raising of this crop. Galveston, New Orleans, Birmingham, Savannah, Columbia, and many other southern cities owe much to cotton, while railroad and steamship lines are furnished a large amount of business in transporting the raw product.

Corn requires for its successful cultivation a higher temperature than does wheat. The corn belt in our country is therefore found south of the wheat belt. The industries of hog raising and pork packing are very closely related to that of corn growing. Hence we find hog raising to be an important industry in the corn belt, and here are found also the great pork packing centers—Chicago, St. Louis, Kansas City and Omaha.

The date of the first killing frost is very important as applied to the corn crop. For example the first killing frost may occur two weeks or even a month earlier than the average time of the same event.. This would usually mean a tremendous loss in the case of crops not matured. At Davenport, Iowa, the average date of the first killing frost is October 12th, while the earliest recorded date of the same is September 18th. At Keokuk, Iowa, the average date is October 22nd; the earliest recorded date is September 18th. At Lincoln, Nebraska, the average date is October 8th, while the earliest recorded date is September 12th. The industry of corn growing, so important in the United States, is entirely absent in Great Britain because the summer temperature is not sufficiently high. As a result, comparatively few hogs are raised in the British Isles and most of the pork consumed there must be imported.

Favorable temperature conditions make possible the extensive growing of the mulberry tree in the valley of the Rhone. Hence silk worms are raised in great numbers in south-eastern France and as coal is close at hand, the manufacture of silk cloth and ribbons is highly developed. The city of Lyons owes its importance in some measure to the silk industry.

Citrus fruits cannot be grown in regions where the temperature falls much below the freezing point. The area well adapted to the growing of these fruits is, therefore, very limited. Florida is subject to cold waves because a great body of land lies to the windward. The land, through

rapid radiation of heat, develops a low winter temperature. The eastward moving atmosphere is therefore chilled. As a result one of the great industries of the state, the growing of these fruits, has suffered severely. In 1894 and 1895, according to the official records at Jacksonville, Florida, a temperature as low as 14° F. occurred, while in 1899 the mercury fell to 10° F.

Southern California, although farther north than Florida, does not suffer from the cold waves because a great ocean, subject to very slight temperature range, lies to the windward. As a consequence, California produces the bulk of the oranges and lemons grown in the United States, and thousands of cars are required annually for the shipment of the fruit to eastern points.

Temperature exerts a marked control over the commerce of Russia because her southern and western ports are blocked by ice for several months each year. Even Vladivostok requires the services of an ice breaker for a short time each winter.

The commerce of the German Empire is temporarily checked each year because of low winter temperatures. Navigation is interfered with on the upper Elbe and Oder for about eighty days. The port of Stettin is ice bound for sixty-one days yearly, Lubeck for thirty-two days, Tilsit one hundred thirty-four days and Memel one hundred forty-two days.

In Alaska modes of transportation are completely changed with the change from summer to winter. During the summer the Yukon is a great highway of commerce, but during the winter this, and all other streams, are closed by ice and all commerce and travel are by sleds drawn by dogs or reindeer, or on foot. The opening of the rivers is an event of great importance to the people who for so many months have been shut in from the outer world.

The commercial importance of the St. Lawrence and the Great Lakes is greatly decreased by the same cause. The Great Lakes are open to commerce for about eight months yearly. The amount of wheat, lumber, iron and copper shipped east, and coal shipped west is enormous. On the average four vessels per hour pass Detroit during the open season. This gives some idea of the loss which results from inability to use this great natural highway for four months of each year. During the winter considerable of Canada's commerce is diverted from the St. Lawrence to Portland, Maine, and Halifax, Nova Scotia, because these ports are never closed by ice.

RAINFALL

The distribution of rainfall, both as to amount and time, exercises an important control over products and industries. In general it may be said that the annual amount of precipitation necessary for successful agriculture without irrigation is twenty inches. Lying west of the one hundredth meridian, and east of the Rocky Mountains is a vast area

where the average annual precipitation is less than twenty inches. In most of the Great Basin it amounts to less than ten inches annually.

In these areas, therefore, with the exception of such portions as are now, or can in the future be placed under irrigation—a small part of the whole—agriculture can never be highly developed. Broadly speaking neither manufacturing nor commerce will ever assume large proportions in “the land of little rain.” There are very extensive areas in Asia, Africa and Australia which, owing to lack of moisture, must always remain practically uninhabited, and therefore not commercial regions.

In order that agriculture without irrigation may be profitably carried on, the precipitation should be advantageously distributed as to time. In a large part of the United States east of the one hundredth meridian, the precipitation, which averages thirty to forty inches annually, is usually sufficient during the summer season. This is a matter of great importance to the growing crops. In Iowa fifty-one per cent of the total annual precipitation occurs between May first and September first. The occasional occurrence of a long continued summer drought results in a serious shortage in corn, wheat, oats, and other crops. This was well illustrated by the droughts which occurred in Iowa and Nebraska in 1894 and 1901. In both years the corn crop suffered greatly. A timely rain occurring in Kansas and Nebraska in 1900, and continuing for twenty-four hours, increased the value of the corn crop by \$80,000,000.

In California the distribution of rainfall, while very different from that in the middle and eastern sections of our country is, at the same time, advantageous in the highest degree to certain well developed industries. Fruit drying, which is carried on during the summer months, and the raisin and bean industries which occur in the autumn, would be very seriously interfered with by rains during those seasons. The harvesting of wheat is greatly facilitated by the dry summers, as the grain is not lodged by storms, and the sacks of wheat can be left in the fields for weeks without danger. During the summer and most of the autumn, the state is practically without precipitation, most of it being received between December first and April first.

A deficiency of rainfall in regions where irrigation can be practiced has other economic and social advantages. Crops are much more certain than they are in areas where rainfall is depended upon, and several crops are usually raised each year. Holdings are generally smaller than in non-irrigated regions, and cooperation is resorted to in the development and distribution of water. Thus the rural population is more dense than it would otherwise be. Towns spring up. In response to demand, manufacturing develops, and transportation facilities and social advantages come rapidly. The great Imperial Valley, as well as Southern California in general, and the irrigated portions of all of our western states, are excellent illustrations. .

In regions where rainfall is limited to one season, and irrigation is not practiced, people are sometimes, as a direct consequence, nomadic. Flocks and herds must be driven from place to place in order to secure the necessary pasturage. Under such conditions permanent settlements, industries, commerce, and social stability are lacking. Arabia furnishes a good illustration of this.

India, a land of seasonal rainfall, depends almost wholly upon the southwest monsoon. This moisture bearing wind striking against the Western Ghats and, in its further progress against the lofty Himalayas, deposits an abundance of moisture upon their windward slopes.

"The monsoon is the yearly salvation of the millions that live on the fruits of the soil. A good or a bad monsoon is the criterion of plenty or of famine. By it India lives; without it there is starvation, death, and misery. The anxiety, therefore, with which all, from highest to lowest, look out for the first warning telegrams from the Seychelles or Mauritius of these indications which are the forerunners of the yearly rain-supply may well be imagined." Holdrich, *India*, p. 348.

Floods often seriously affect industry and commerce. Floods may result from unusually heavy rains, or from melting snow, or both. A "warm spell" may cause the snow to melt when the ground is not sufficiently thawed to absorb much water. In 1903 floods in the Mississippi valley did great damage to railroad and other property. On January 1, 1910, a washout put a stop to all through traffic on the Salt Lake Railroad. Business was not resumed until June 11, 1910. The loss amounted to millions of dollars.

THE WINDS

In the past the winds exercised a strong influence upon commerce. The progress of sailing vessels has always been and is today more or less determined by the direction, constancy and velocity of the wind. Vessels of this class require a little longer time in making the voyage from western Europe to America, than on the return trip.

Had Columbus sailed westward from France, Germany or England his voyage of discovery might have been a failure for he would have had the westerly winds with which to contend. Sailing southward to the twenty-eighth parallel, which according to Toscanelli's map passed through Cipango or Japan, and then directly west, he was helped onward by the trades. Thus the discovery of America, and the portion of it settled by the Spaniards, was in a measure due to the winds.

It is then apparent that the life of man, and the industrial and commercial development of the world, are profoundly influenced by climate. As man develops, unfavorable climatic environment is, in a measure, overcome. But while this is true, so long as human beings require food, clothing and shelter, just so long will climate exercise a powerful control over mankind.



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